REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Office Action dated May 9, 2003 (U.S. Patent Office Paper No. 6). In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

Status of the Claims

As outlined above, claims 1, 9, 10, 11, 14, 16, and 19, are being amended to correct formal errors and to more particularly point out and distinctly claim the subject invention.

Prior Art Rejections

Claim 1 was rejected under 35 U.S.C. §102(b) allegedly being anticipated by Sasaki *et al.*, U.S. Patent No. 5,607,718 (further, the '718 patent). Applicants respectfully traverse this rejection.

At least in one instance, regarding "Example 13" the '718 patent recites:

"As the polishing pad 83, a material formed by adhering a foam polyurethane layer on an unwoven fabric and having a total thickness of 1.5 mm and a Shore hardness material prepared by dispersing 20 wt % of silica particles with a mean particle size of 30 nm in hydrogen peroxide water added with an oxidizing agent was used. "

The reference discloses a method of polishing using free abrasives with a polyurethane polishing pad and a slurry containing grinding particles.

In contrast, the present invention as recited by amended claim 1, discloses: "using a grindstone formed of abrasive grains and a resin binder for binding and retaining the abrasive grains". It also discloses a polishing process using half-fixing grinding particles along with a grindstone and additive.

The Examiner contends on page 2, section 2 of the Office Action that "Note that a material prepared by dispersing 1.0 wt % of amorphous carbon particles (same as grindstone) with a mean particle size of 0.4 μm in pure water was used as a polishing agent".

In light of the above highlighted difference between the '718 reference and the present invention, the selection regarding diameters of grinding particles, the selection of grinding particles and the usage purpose of additives is made in two different contexts, therefore they are addressing two different subject matters.

The '718 reference recites in col. 2, lines 9 – 26 that : "In an actual polishing process, however, the surface to be polished of the interconnecting metal film 3 is damaged and roughened by a mechanical action between the surface of the metal film and polishing particles or between the surface and a pad for holding a polishing agent, or polishing particles are buried in or left behind on the interconnecting metal film 3. In addition, as shown in FIG. 1F, a phenomenon termed dishing takes place in which the thickness of a central portion decreases in particularly a wide region of the interconnecting metal film 3 buried in the trenches or openings. This tendency appears conspicuously when a metal having a low hardness and a high ductility, such as Al or Cu, is used as the material of the interconnecting metal film 3. The occurrence of flaws or dishing, or the residue of polishing particles on the surface of an interconnecting metal film increases the resistance of resulting interconnections or causes disconnections, leading to a decrease in reliability or in product yield. "

In order to overcome the "dishing" problem and implicitly to avoid obtaining low planarity after polishing, the '718 reference suggests using an abrasive having finer particles, with diameters of 0.01 - 0.11μm, that have smaller diameters than the ones embedded in the material to be polished and in the polished pattern. Dishing is also reduced by adopting as an abrasive aspherical, shaped organic high molecular material. Another alternative suggested by the reference is using a general technique for dispersing organic high molecules or adding ammonium polycarboxylic for improving the pH-rate of the CuO_x metal compound. Thus, the approach the '718 reference takes regarding eliminating the dishing is that polishing is performed using a polyurethane polishing pad.

In contrast, the present invention does not recite, with respect to the "polishing and planarizing the surface" step of claim 1, using a polyurethane polishing pad but instead a grindstone. The grindstone is highly planarized, so a problem such as "dishing" does not appear.

Another characteristic that distinguishes the present invention from the one disclosed by the '718 reference is that the best range for the particle diameter of the abrasive material is 0.1 - 0.4 μm, as disclosed in the specification, page 12, line 26, to page 13, line 11.

The '718 reference recites the use of hard inorganic oxides as abrasives. In contrast, the present invention recites the use of soft organic high molecular material. In the present invention, organic high molecular materials are used as a binder with the purpose of fixing abrasives and they do not contribute to polishing. Please see the Specification, page 19, line 2 to page 20, line 19.

Further, the purpose why the additive is elected as such is because it has excellent planarity and eliminates problems induced by grindstone polishing such as the deterioration of the equality of polishing. It also helps increase the removal rate and to reduce the selection rate. Please refer to the Specification page 10, line 28, to page 11, line 13.

Further, the '718 reference discloses the use of a polyurethane polishing pad for polishing soft metal films. The present invention discloses the polishing being performed by grindstone polishing, especially when polishing is done for two kinds of hard films, $S0_2$ and SiN, as disclosed by amended claim 1 and its dependent claims.

The '718 reference recites the use of fine abrasives having particle diameters of 0.01 - 0.1 μm. Due to their fine diameters they have high manufacturing costs, a process cost based on transportation costs, distribution costs, and a cost for preventing agglomeration in its distribution system. The cost of using a slurry with these particles is much higher in comparison to using a grindstone for polishing.

According to the present invention, in polishing with the grindstone, the polishing is realized due to mechanical friction. The process disclosed by the present invention allows as an alternative the replacement of this polishing method with a slurry based one, containing the conventional polyurethane polishing pad and the abrasives with high planarity and having additives.

Further, with respect to the application of an additive, the additive material having the effect of dispersing the particles of slurry disclosed in the '718 reference does not improve the quality of grinding results when using a grindstone nor the selective polishing between two films. The above feature is novel and Applicants, after review of the '718 reference, could not find this feature disclosed by Sasaki *et al.*

In view of the differences outlined above, Applicants respectfully request the Examiner to reconsider claim 1. Due to the above exhibited differences, the '718 reference does not anticipate claim 1. Therefore, the Examiner is respectfully asked to withdraw the rejection and to pass the claim to issue.

Claims 5, 6, 7 and 9, depend from and add features to an allowable independent claim. Therefore, Applicants contend that they are allowable for the reasons exhibited above and for reasons contained therein.

Claims 2 and 10 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Sasaki *et al.*, U.S. Patent No. 5,607,718, and in further view of Hosali *et al.*, U.S. Patent No. 6,132,637. (further, the '637 reference). Applicants again respectfully traverse.

Claims 2 and 10 depend from and add features to allowable independent claim 1. Therefore, they are also allowable over the Sasaki reference for at least the reasons Applicants outlined above regarding claim 1, in addition to the reasons outlined by the Examiner on page 4, lines 5 – 7 of the Office Action.

Both references that constitute the basis for this rejection disclose a slurry containing polishing abrasives using a polyurethane polishing pad.

For a structure comprising a soft polyurethane polishing pad and the slurry, the force applied to the worked piece by the structure is weak. The chemical process occurring between the surfaces is in large part responsible for polishing since the total surface area of fine abrasives free in a liquid is large. Thus, the additives acting as surfactants change the polishing rate or selection rate of the polished object by a large degree.

In the '718 reference, the surface area is being increased so as to perform a chemical reaction and the particle diameter is accommodated to be superfine in order to prevent dishing due to weak physical operation that superfine abrasives of 0.01 - 0.1μm are suitable thereto.

In contrast, the present invention discloses a hard grindstone pad as a polishing means for which the polishing is achieved by the physical process applied to the surface. The effect of improving the selection rate of a polished workpiece by an additive is not an expected and obvious effect. In combination with the process disclosed by the present invention in claim 1, by adding an additive having an average particle diameter of 0.1 - 0.4 μm and polycarboxylic acid, the high planarity provided by a grindstone coexists with the remarkably improving effect in the selection rate of polished workpiece by the additive.

This combination and its reasons thereof are not obvious in view of disclosures made in '718 and '637 references.

Due to the fact that the above references nor singly or in combination, as explained above, disclose all the features recited by claims 2 and 10, they do not anticipate claims 2 and 10. Also, claims 2 and 10 depend from and add features to an allowable independent claim. Therefore, Applicants contend that they are allowable for the reasons exhibited above and for reasons contained therein.

Claims 2, 3, 4, and 8 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Sasaki *et al.*, U.S. Patent No. 5,607,718, and in further view of Kimura, U.S. Patent No. 5,869,392 (further, the '392 reference). Applicants again respectfully traverse.

The arguments made above in connection with the rejection formulated against claims 1, 2, 5, 6, 7, 9, and 10, apply. In addition, Applicants would like to bring to the Examiner's attention the following facts:

The polishing process using a grindstone pad is used primarily for its physical effects on the polished surfaces and due to the additive that considerably improves the selection rate of the polished workpiece. The grindstone disclosed in the present invention differs from general grindstones due to the diameter of its particles, an average diameter of 0.1 - 0.4 μm. Such diameter values are not difficult to be found in slurries. It is very rare to find grindstones with this range of particle diameters because the particle diameter in powders sold is less than 1 μm. It is also difficult to produce a uniform grindstone since the surface energy prevents the particles to be agglomerated uniformly. If an organic resin binder is used, as in the present invention, a suitable technique for uniform mixing and kneading with the abrasives is needed. The method recited by the present invention was uncovered as a response to the above described need.

The grindstone pad configured according to the present invention is the result of the development of a technique of producing a grindstone for reforming fine abrasive processes while pre-expecting remarkable effects. The addition of an additive is made for improving the selection rate of the polished workpiece as polishing is performed. Sasaki *et al.* and

Kimura *et al.* neither singly nor in combination makes any suggestion about the above features.

Due to the fact that the above references neither singly nor in combination, as explained above, disclose all the features recited by claims 2, 3, 4, and 8, they do not anticipate these claims. Also, claims 2, 3, 4, and 8 depend from and add features to an allowable independent claim. Therefore, Applicants contend that they are allowable for the reasons exhibited above and for reasons contained therein.

Claims 11 –13, 14, 15, 16, and 17 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Sasaki *et al.*, U.S. Patent No. 5,607,718, in view of Hosali *et al.* and in further view of Kimura, U.S. Patent No. 5,869,392 (further, the '392 reference). Applicants again respectfully traverse.

The differences between the subject matter disclosed by these claims and the cited references are the same as the ones outlined in response to the previous rejections. Further, with respect to controlling the additive concentration during working by using a grindstone pad, an important advantage is provided. In a slurry, the additive's concentration needs to be coordinated with the slurry's stability (agglomerate and surface active in a long time) and cannot be selected by only selection rate to the polished work piece. For example, if the selection rate of the polished work piece is very high and the concentration of dispersant is high, the absorption degree of dispersant to the abrasive surface is high (therefore, the selection rate is also high), such that micell is formed in the slurry. Further, agglomerate does not maintain stability. When the concentration of dispersant is low, the agglomerate deteriorates. In Sasaki *et al.*, Hosali *et al.* and Kimura *et al.*, the concentration of dispersant is limited by restriction regarding the slurry's stability, while in the grindstone pad, as in the present invention, there is no slurry used, so the restriction related to its dispersion does not exist. The concentration of dispersant can be changed, as disclosed by the present invention, with remarkable advantages especially in combination with the grindstone pad. Such an advantage is not recited by neither Sasaki *et al.*, Hosali *et al.*, and Kimura *et al.*

Claim 19 is rejected under 35 U.S.C. §103(a) allegedly being unpatentable over Sasaki *et al.*, U.S. Patent No. 5,607,718, in view of Hosali *et al.* Applicants again respectfully traverse.

Regarding the application of the disclosed process to a semiconductor fabrication, the present invention is different from Sasaki *et al.* and Hosali *et al.* due to the advantageous effects induced by the utilization of a high planarity polishing device. In contrast to Sasaki et al. and Hosali et al, the present invention does not disclose using a polyurethane polishing pad and a slurry. It discloses using a stone having high planarity. Even after lengthy polishing, dishing does not appear. This allows the process to be used for forming a reverse pattern of an element, or back etching. Please see page 7, lines 5 to 19, of the specification and S. Katagiri, *et al.*, "CMP Using Fixed Abrasive Tool (FX-CMP) for Dielectric Planarization", Extended Abstracts of 20011 SSDM, 2001, pages 16 to 17. The present invention shows advantages over the disclosure of the references by achieving short periods and low costs in a manufacturing process thereof by using the grindstone and the dispersant.

Due to the above outlined advantages that are not referenced in any of the references, the subject matter disclosed by claim 19 is distinguishable over the references. Applicants respectfully ask the Examiner to reconsider its rejection regarding claim 19.

Claims 20, and 21 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Sasaki *et al.*, U.S. Patent 5,607,718, in view of Hosali *et al.* and in further view of Kimura, U.S. Patent No. 5,869,392. (further, the '392 reference). Applicants again respectfully traverse.

As mentioned above in response to paragraphs 6 and 7 of the Office Action, Sasaki *et al.*, Hosali *et al.* and Kimura *et al.* disclose polishing using polyurethane polishing pad + and slurry containing abrasives, while the present invention relates to the polishing using the grindstone. The grindstone is capable of improving planarization in an element separation process. As to a control of concentration of added dispersant, in the grindstone pad polishing process disclosed by the present invention, that mentions no limitation regarding adding the dispersant in the most suitable concentration for stability of the slurry, most suitably the value of the dispersant's concentration can be selected from a broad range thereof, in consideration of only selection rate of the polished workpiece and the polishing rate.

CONCLUSION

In view of all the above, Applicants respectfully submit that certain clear and distinct differences as discussed exist between the present invention as now claimed and the prior art references upon which the rejections in the Office Action rely. These differences are more than sufficient that the present invention as now claimed would not have been anticipated nor rendered obvious given the prior art. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application as amended is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicant's undersigned representative at the address and phone number indicated below.

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